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Electrocoat Primers for the Aerospace Industry

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Enhanced Coating Systems for the Aerospace Industry



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The new generation of aircraft substrates combined with environmental regulations present challenges to develop new materials and/or processes for painting.

PPG has responded to the need for Cr(VI)-free coatings via two pathways:

➤ Elimination of Cr(VI) in conventional coating systems

- Cr(VI)-free conversion coating
- Cr(VI)-free sol-gel surface treatment
- Spray primer containing novel corrosion inhibitor pigments

➤ New coating process

- Electrocoat primer - Aerocron™



Electrocoat Primers for the Aerospace Industry



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- Electrocoat Basics
- Why Electrocoat
- Electrocoat Process
- Test Results
- Conclusions



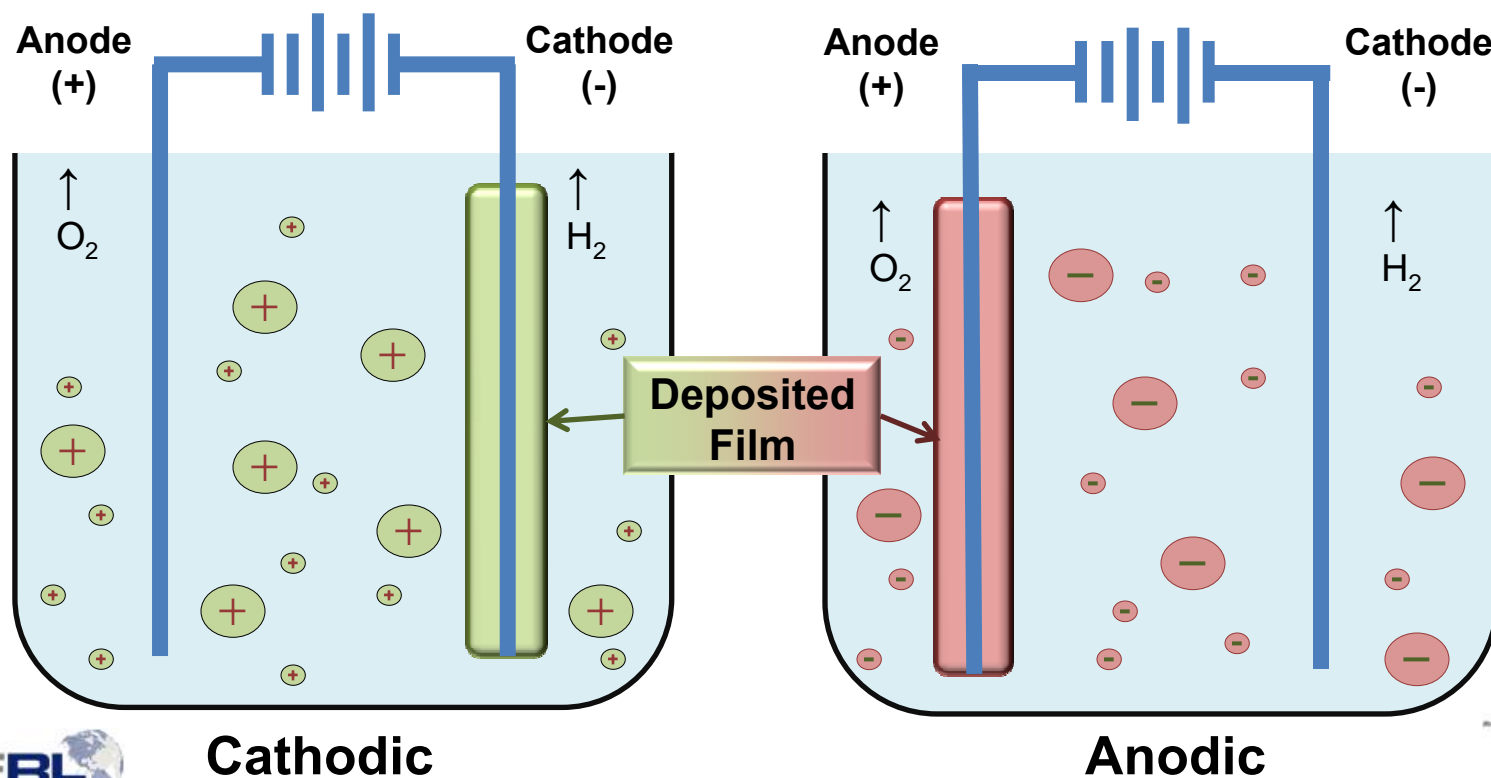
Electrocoat Basics



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- Electrodeposition Process

- Method of applying a coating which uses electrical current to deposit aqueous dispersed resins and pigments onto a conductive substrate
- Coatings can be applied via anodic or cathodic deposition



Cathodic vs. Anodic Electrocoat

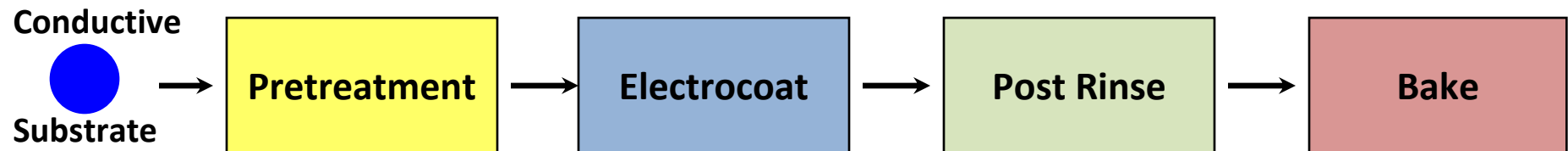
➤ Cathodic

- Positively charged paint particles
- 300°F or higher cure
- Excellent corrosion resistance for Ferrous substrates
 - Armor, ground support equipment, munitions

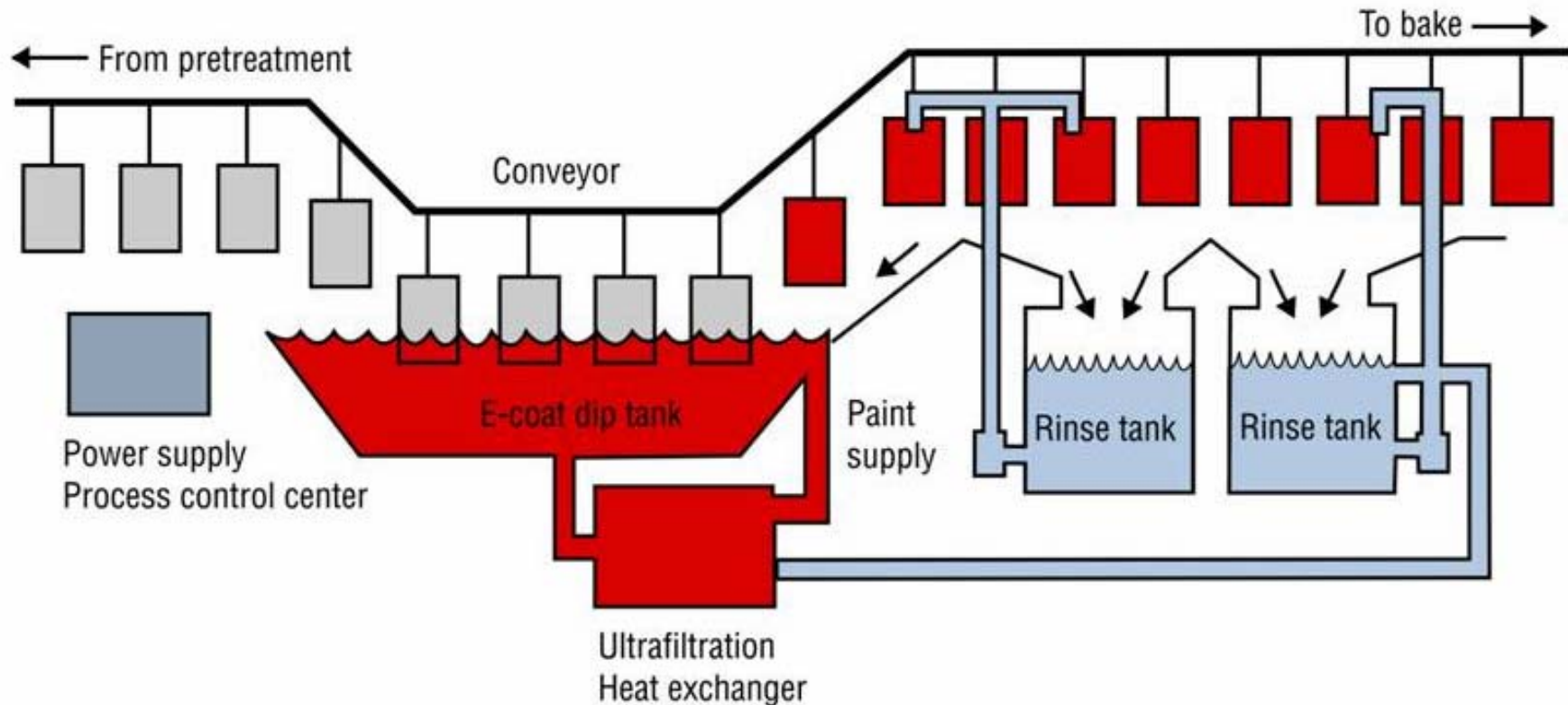
➤ Anodic

- Negatively charged paint particles
- Lower temperature cure 200 – 250°F
- Especially applicable to Aluminum substrates
 - Aircraft, wheels, light weight vehicles

Typical Electrocoat Process



Components of an Electrocoat Conveyor Process



Why Electrocoat for Aerospace?



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➤ Environmental, Health and Safety Considerations

- Aqueous based
- Minimal waste discharge – closed loop process
- Minimal exposure of workers to hazardous materials

➤ Productivity / Efficiency

- Automated process – increased productivity
- Virtually 100% materials utilization
- Immediate part handling after thermal cure (30 minutes @ 200 °F)
 - Do not have “dry to touch”, “dry to tape”, “dry to fly” restrictions

➤ Application / Performance

- Uniform film across entire surface including recessed areas
- Excellent barrier / corrosion resistance properties



EH & S and Productivity Considerations



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Conventional Solvent based spray coating process



- Use of PPE required
- Labor intensive

Standard OEM Electrocoat process



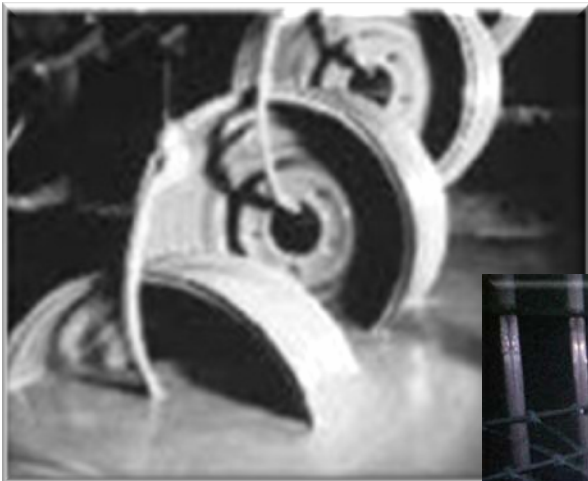
- Aqueous based coating
- Automated process minimizes worker exposure

Application Considerations



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- Ability to coat complex shapes



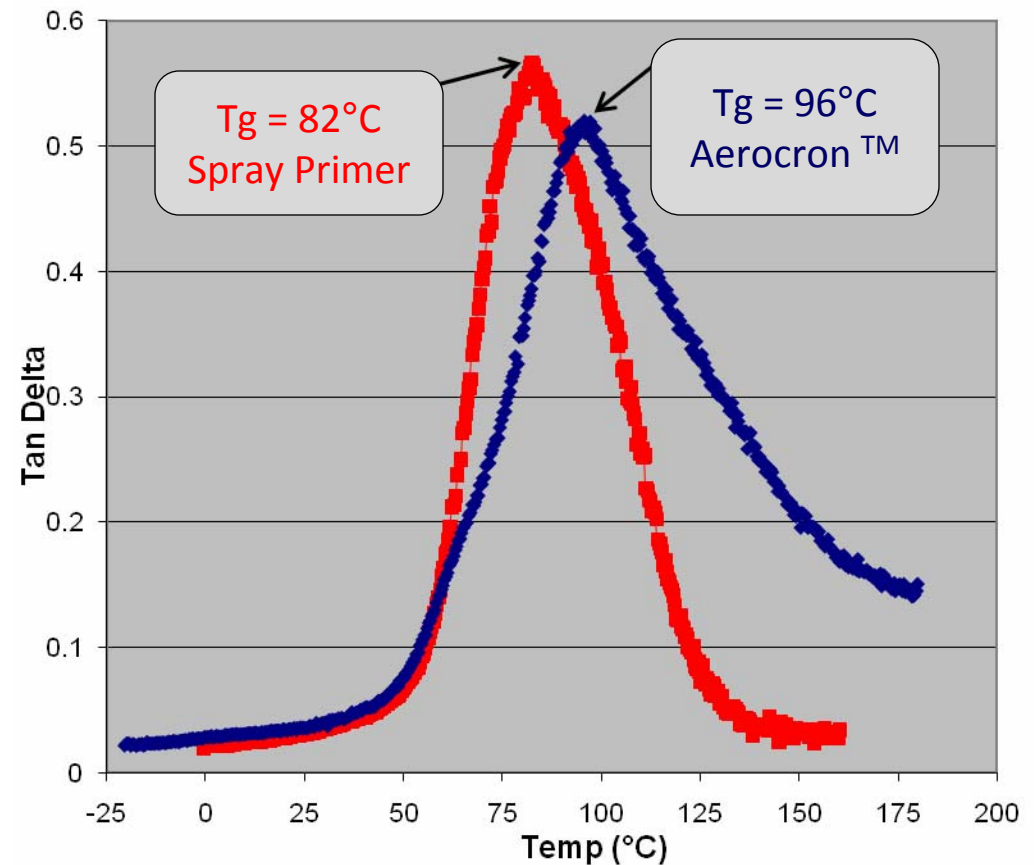
Performance Considerations



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- Uniform Coating Thickness
- High Crosslink Density
- Good Barrier Properties

Dynamic Mechanical Analysis



Coating Performance Criteria

Spray Applied Coatings



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➤ Various Aerospace Specifications

- MIL-PRF-23377J
- BMS 10-11Y
- BMS 10-79M
- MIL-PRF-85582
- MIL-PRF-85285

➤ **Key Performance Criteria**

- **Corrosion**
- **Fluid Resistance**
- **Adhesion**
- **Flexibility**

➤ Key Application Criteria

- Mixing and Dilution
- Viscosity
- Pot life
- Cure / Drying Time

Coating Performance Criteria

Electrocoat Primer Coatings



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Draft of Aerospace Electrocoat Primer Specification

- AMS G8 Aerospace Organic Coatings Committee - passed July 2009
- Awaiting Aerospace Council review / approval

➤ **Key Performance Criteria**

- **Corrosion**
- **Fluid Resistance**
- **Adhesion**
- **Flexibility**

➤ **Key Application Criteria**

- Electrocoat Parameters (solids, pH, conductivity)
- Electrocoat Temperature
- Thermal Cure Conditions

Test Results – Adhesion

➤ Dry Adhesion - **PASS**

- requirement better than 7 rating per BSS 7225

➤ Water Resistance – **PASS**

- 4 days immersion at 120°F
- No wrinkling, blistering or other coating deficiency

➤ Humidity Resistance – **PASS**

- 30 days at 120°F with condensing humidity conditions
- No loss of adhesion, blistering, or other visible defects

Test Results – Physical Properties

➤ Pencil Hardness - **PASS**

- Minimum hardness of F

➤ Solvent Resistance – **PASS**

- 50 passes with MEK with no rub through to metal

➤ Flexibility – **PASS**

- Room Temperature (75°F)
- Low (4 hours @ -70°F)
- High (70 hours @ 350°F)
- Temperature Shock (160°F to -65°F)

➤ Impact Resistance - **PASS**

- No cracking/ loss of adhesion in 50 in/lbs fwd & 30 in/lbs reverse

Test Results – Fluid Resistance

➤ Fluid Resistance – **PASS**

- Fluids evaluated

- Skydrol LD4

- Jet A Fuel

- Turbo 2380 Engine Oil

- No blistering, wrinkling or other visible defects, minimum HB pencil hardness after 30 days of immersion

Test Results – Corrosion

➤ 3000 Hour Salt Fog Corrosion - **PASS**

- No blisters or loss of adhesion beyond 1/8 inch from scribe after 3000 hrs of 5% salt spray exposure

➤ SO2 – **PASS**

- Mean creepage from scribe \leq current corrosion protection system
- Per Joint Test Protocol J-00-GV-001-P1

➤ Filiform – **PASS**

- No blisters or loss of adhesion beyond 1/8 inch from scribe after 30 days of humidity exposure

Aerocron™ Electrocoat Performance



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**Salt Fog
(ASTM B117)**

3000 Hours

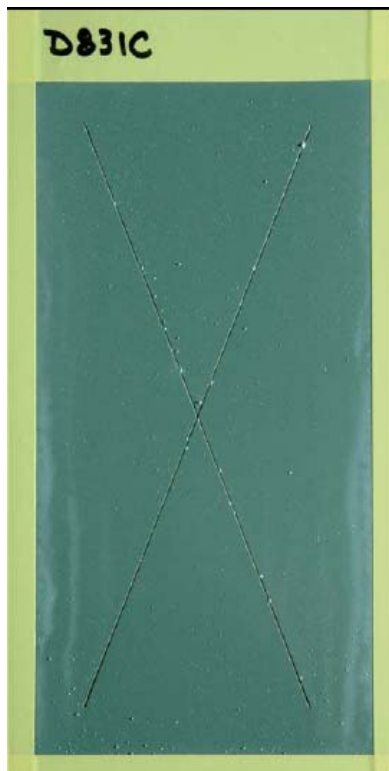
**Non-Cr electrocoat over
Cr (VI) pretreatment**

**Non-Cr electrocoat over
proprietary Cr-free pretreatment**

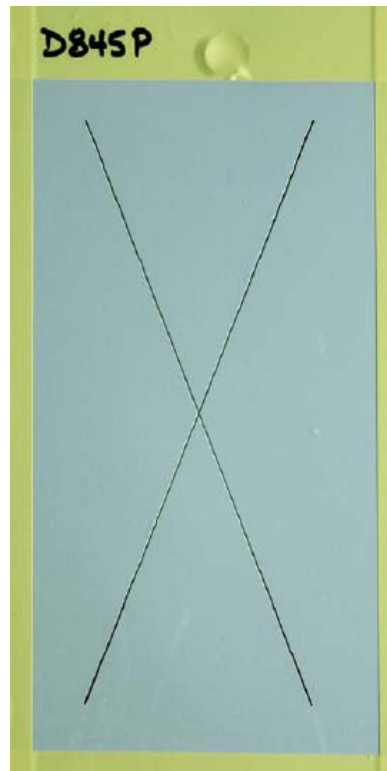
**Commercial Cr (VI) spray primer with
Cr (VI) pretreatment**

SO₂ testing

336 hours



Commercial Cr (VI) spray
primer with
Cr (VI) pretreatment



Non-Cr Electrocoat
with
Cr-free pretreatment



Commercial Cr (VI) spray
primer with
Cr-free pretreatment

Test Results – Beach Exposure

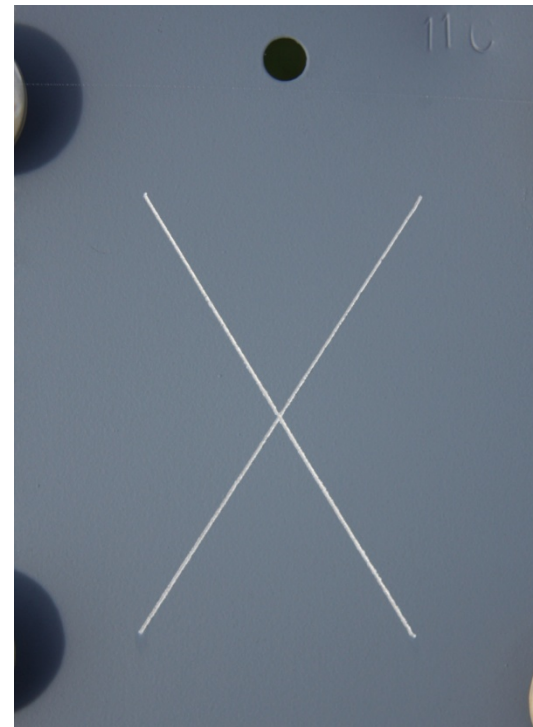


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Kennedy Space Center



3 months



Topcoated
Commercial Cr (VI) spray primer
with Cr (VI) pretreatment

Topcoated
Non-Cr Electrocoat
with Cr-free pretreatment

Electrocoat Primers for the Aerospace Industry

- Electrocoat primers can provide good performance relative to conventional spray primers
- Advantages of Electrocoat
 - Increased productivity
 - Mitigation of Cr(VI)
 - Full automation
 - Lower waste disposal costs
 - Increased material utilization
 - Uniform coating of complex parts
 - Overall weight reduction

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